



**UNIVERSITI PUTRA MALAYSIA**

**AGROECOLOGICAL ZONES, AGRICULTURAL LAND REGIONS  
AND CROP SUITABILITY CLASSIFICATION FOR KOTAWARINGIN  
BARAT REGENCY, KALIMANTAN, INDONESIA**

**ANDY BHERMANA**

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**AGROECOLOGICAL ZONES, AGRICULTURAL LAND REGIONS AND  
CROP SUITABILITY CLASSIFICATION FOR KOTAWARINGIN BARAT  
REGENCY, KALIMANTAN, INDONESIA**

**By**  
**ANDY BHERMANA**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,  
in Fulfilment of the Requirement for the Degree of Master of Science**

**September 2002**



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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**September 2002**

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In land use, not all lands can be optimally used for agricultural purposes because each land is influenced by its natural environment that consist of three main elements: land (soil), climate, and crop. The information of these elements is urgently required as a basic consideration in agriculture and area development planning process.

The information of natural environment can be organized into a system of agroecological zone (AEZ) that represent homogeneous biophysical environment condition and refers to the division of an area of land into smaller units, which have similar characteristics related to land suitability.

The study was conducted in Kotawaringin Barat Regency, Kalimantan, Indonesia and consists of three main part, i.e. developing agroecological zone (AEZ) system, establishing agricultural land regions, and determining land suitability for some

existing crops. The expert system called Land Use program was employed to interpret the basic data. The data inputs and results in the form of digitized maps are component of geographic information system (GIS), which facilitates future utilization, updating, improvement, storing, and displaying.

On the basis of climatic and land characteristics data at reconnaissance level with scale of 1: 250,000, and considering that Kotawaringin Barat regency has four slope classes and isohyperthermic temperature regime with the existence of udic moisture regime, this regency is divided into four main zones (I, II, III, and IV) and four sub-zones (IV.1, IV.2, IV.3, and IV.4). As recommended by expert system, zone I and sub-zone IV.2, IV.3 and IV.4 should be allocated for forest to protect natural resources and environment in general, zone II can only be utilized for permanent or perennial crops plantation, zone III for agroforestry, and sub-zone IV.1 for annual crops farming.

On the basis of agroecological zone (AEZ) system, the present land use can then be changed according to agroecological conditions. Comparison of present land use and AEZ leads to general recommendations on how to improve and manage the current land use through extensification, intensification, and conservation.

In order to get more detail and direct information on land suitability for use by specific crop, land evaluation for several crops was carried out in extensification areas that have zonation system for cultivation. On the basis of data available at

reconnaissance level, land characteristics were then considered as basis for land evaluation. Seven existing crops were selected and twelve land systems as land units were used to analyze the land evaluation system.

The result shows that there are general restrictive factors in each land mapping unit. The general restrictive factors that indicated the need of soil management involve slope, soil depth, cation exchange capacity (CEC), and rainfall for rubber; slope, CEC, base saturation, pH, and rainfall for oil palm; slope, texture, base saturation and pH for maize; slope, base saturation, pH, temperature, and rainfall for soybean; slope, texture, pH and rainfall for cassava; slope, texture, and pH for upland rice; texture and pH for wetland rice.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia  
sebagai memenuhi keperluan untuk ijazah Master Sains

**ZON AGROEKOLOGI, WILAYAH TANAH-TANAH PERTANIAN DAN  
KLASIFIKASI KESESUAIAN TUMBUHAN DI DAERAH  
KOTAWARINGIN BARAT, KALIMANTAN, INDONESIA**

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Dalam penggunaan tanah, tidak semua tanah boleh digunakan untuk tujuan-tujuan pertanian kerana setiap tanah dipengaruhi oleh keadaan persekitaran semula jadi yang terdiri dari tiga unsur utama iaitu tanah, iklim, dan tumbuhan. Maklumat daripada faktor-faktor tersebut sangatlah diperlukan sebagai asas pertimbangan dalam proses perancangan di bidang pertanian dan pembangunan wilayah.

Maklumat alam persekitaran dapat disusun ke dalam suatu sistem zon agroekologi yang menggambarkan keadaan persekitaran biofizik yang homogenus dan mengarah kepada pembahagian sebuah daerah kepada unit yang lebih kecil dengan kesamaan ciri-ciri yang berkaitan dengan kesesuaian tanah.

Kajian yang dilaksanakan di daerah Kotawaringin Barat, Kalimantan, Indonesia terdiri dari tiga bahagian utama iaitu mengembangkan sistem zon agroecologi,

menetapkan wilayah-wilayah pertanian, dan penentuan kesesuaian tanah untuk beberapa tanaman. Kajian ini menggunakan system pakar iaitu program Guna Tanah untuk menterjemah data asas. Hasil daripada terjemahan adalah dalam bentuk peta digital sebagai sebahagian daripada sistem maklumat geografi (SMG) yang berfungsi untuk penggunaan masa hadapan, pembaikan, penyimpanan dan penyajian data.

Berasaskan data ciri-ciri tanah dan iklim yang diperoleh dari maklumat pada peringkat tinjauan pada skala 1: 250.000 dan dengan mengambil kira bahawa daerah Kotawaringin Barat mempunyai empat kelas cerun, berejim suhu isohyperthermik, dan berejim air udik, maka daerah ini terdiri dari empat zon utama (I, II, III, dan IV) dan empat sub-zon (IV.1, IV.2, IV.3, dan IV.4). Berasaskan sistem pakar, zon I, sub-zon IV.2, sub-zon IV.3, dan sub-zon IV.4 ditempatkan untuk hutan bagi melindungi sumber asli dan alam sekitar, zon II dapat digunakan untuk tanaman saka, zon III untuk agroforestry, and sub-zon IV.1 untuk tanaman kontan.

Berasaskan zon agroekologi, penggunaan tanah masa kini boleh ditukar. Perbandingan guna tanah masa kini dan sistem zon agroekologi membolehkan syor-syor umum untuk bagaimana membaiki dan mengurus penggunaan tanah masa kini menerusi ekstensifikasi, intensifikasi, dan pemuliharaan.

Untuk mendapatkan maklumat lebih mendalam mengenai kesesuaian tanah, penilaian tanah untuk beberapa tanaman dilaksanakan untuk daerah-daerah

ekstensifikasi yang mempunyai sistem zon untuk penanaman. Penilaian tanah berasaskan pada data yang tersedia pada tingkat tinjauan. Sistem penilaian tanah ini menganalisis 12 sistem tanah (unit tanah) dan 7 tanaman.

Kajian ini menunjukkan bahawa terdapat beberapa faktor pengehad untuk setiap unit pemetaan tanah yang boleh memberikan maklumat mengenai pengurusan tanah. Faktor-faktor pengehad tersebut meliputi cerun, kedalaman tanah, keupayaan pertukaran kation, dan curahan hujan untuk tanaman getah; cerun, keupayaan pertukaran kation, ketepuan bes, pH, dan curahan hujan untuk tanaman kelapa sawit; cerun, tekstur, ketepuan bes dan pH untuk tanaman jagung; cerun, ketepuan bes, pH, suhu, dan curahan hujan untuk tanaman soya; slope, texture, pH dan curahan hujan untuk tanaman singkong; slope, texture, dan pH untuk tanaman padi huma; tekstur dan pH untuk tanaman padi sawah.



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I certify that an Examination Committee met on 3<sup>rd</sup> September 2002 to conduct the final examination of Andy Bhermana on his Master of Science thesis entitled "Agroecological Zones, Agricultural Land Regions and Crop Suitability Classification for Kotawaringin Barat Regency, Kalimantan, Indonesia" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Member of the Examination Committee are as follows:

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## DECLARATION

I hereby declare that this thesis is based on my original work except quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



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## **CHAPTER I**

### **GENERAL INTRODUCTION**

#### **1.1 Background**

The purpose of agricultural development is to increase the standard of living through modern and sustainable agriculture that can support the development of the region. The policy of the Indonesian Government to increase agricultural production has been carried out through intensification, and extensification of land as well as diversification of agriculture. This should be done because agriculture plays a very important role in this country especially in economic development and has also become a key area in increasing the income of the people.

Furthermore, the development of agriculture should be oriented to safe guard the environment and potential natural resources, and has to be carried out without interruption if it is to be effective. Therefore, the management of land use must be applied through suitable and effective methods.

The need for optimum use of land has never been greater than at present, when rapid population growth and urban expansion are making available for agriculture a relatively scarce commodity. The increasing demand for intensification of existing cultivation and opening up of new areas of land can only be satisfied without damage to the environment if land is classified according to its suitability

(FAO, 1983) and sustainable land use can only be permanently implemented if it is based on the aspects of conservation and the capacity of regeneration (Rukmana and Zubair, 1999).

In general, the use of land for agricultural purposes in Central Kalimantan (Borneo) based on ecological conditions has not been implemented, although the live of most of people in Central of Kalimantan depend directly or indirectly on agricultural pursuits for their livelihood. Their ability and knowledge in the process of rapid change and development of agriculture especially about land use are still lower than the people from the other island such as Java and Sumatra. Today, the natural habitat and natural resources in Central Kalimantan has been destroyed mainly due to human activities such as shifting cultivation or slash-and-burn agriculture. In addition to traditional kind of agricultural land use, without the least knowledge of soil conditions, forest has been cleared indiscriminately for illicit timber industry. The present land use patterns and these activities that caused rapid degradation of biological resources and destruction of forest has often led to serious soil erosion and land degradation.

In land use, not all of the lands can be used optimally for agricultural purposes because each land is influenced by its natural environment. The agricultural environment consists of two main elements: soil and climate (Nieuwolt, 1982; Kowal, 1978; Buringh, 1979) and crop growth and the sequences of crops grown are determined by interaction of climate, soil, plant and management factors (Wiradisatra, 1996 and Oldeman and Frere, 1982).

In Kotawaringin Barat regency, because basic data are scarce, the interpretations of these facts in relation to agriculture are still lacking. There are only some districts such as Kumai and Arut Selatan that usually well acknowledge both the soil and climate factors in cultivation. The other districts still often neglect these factors in land use and agricultural planning. Farmers know how to overcome the risk of crop damages and failures as low as possible and they based their knowledge often only on experience.

These conditions and problems indicate that the need for land use planning to systematically allocate land resources for major land use types is urgently required. The goals of land use planning are related to sustainable agriculture that can ensures the resources may be used for future generation and also ensure that people can benefit from nature during their lifetime.

The information of natural environment on the basis of land resources and climate that can influence on agriculture, however, is urgently required. This information is the basic consideration in agricultural and area development planning process. For easy reference in land use planning, it is then possible to be organized in a system of zonation. These will represent approximately homogeneous climate conditions. When the effects of soils and landform on agricultural activities are also considered, the natural environment in each region can be generalized. They are therefore called agroecological zone (AEZ).

Agroecological zone (AEZ) refers to the division of an area into smaller units, which have similar characteristics and homogeneous natural environment conditions (Amien, 1997), and it is also related to land suitability, potential production and environmental impact (FAO, 1996).

Agroecological zone (AEZ) can be as a system for evaluating sustainable land uses and as such provides a conceptual framework encompassing characterization of environment and land utilization practices. With the agroecological approach, sustainable agriculture can be attained when proper land utilization is practiced.

Optimum agricultural land use is sought through agroecological zone (AEZ), whereby the right choice of crops is grown in regions with homogeneous climate and soil. When crop groups or individual crops needs are matched to combination of climate and soil conditions, it is then possible to cultivate the land based on land suitability and soil capability.

As the initial stages towards precision agriculture, agroecological zone (AEZ) system attempt to provide the information on land as the right location for cultivation. Land utilization that refers to use on a sustained basis and based on precision agriculture leads to sustainable agriculture. In precision agriculture, the elements of biophysical environment such as landform, climate and vegetation, therefore, should be considered in land utilization

In addition to achieve sustainable agriculture, the major strategy for agricultural production has been established by Indonesian government through bringing more land into use (extensive cultivation) and intensification of agriculture linked with resource conservation and protection in areas already opened for cultivation.

With agroecological approach, the precision agriculture in the future can be achieved through proper land use. Furthermore, agroecological zone (AEZ) system is expected to be useful in efficient planning and designing of land resources for sustainable land use. It will significantly expand the agricultural growth, ensure food security, and above all conserve land for future generation.

## **1.2 Objective of The Study**

The objective of this study was to establish the agroecological zones, agricultural land regions and land suitability for several existing crops in Kotawaringin Barat Regency, Kalimantan, Indonesia. Thus, this study attempted to provide the basic information of natural environment as a reference in agricultural development and land use planning.



**1.3 The Specific Objective of The Study were to:**

- a. To characterize and classify natural resources into zones using agroecological approach and geographic information system for land use planning.
- b. To determine agricultural land region.
- c. To develop agroecological zone map.
- d. To develop land use recommendation map.
- e. To develop land suitability maps for existing crops.